

River Habitat Modeling for the Entire Macroinvertebrate Community

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Abstract : Habitat models rarely consider macroinvertebrates as ecological targets in rivers. Available approaches mainly focus on single macroinvertebrate species, not addressing the ecological needs and functionality of the entire community. This research aimed to provide an approach to model the habitat of the macroinvertebrate community. The approach is based on the recently developed Flow-T index, together with a Random Forest (RF) regression, which is employed to apply the Flow-T index at the meso-habitat scale. Using different datasets gathered from both field data collection and 2D hydrodynamic simulations, the model has been calibrated in the Trebbia river (2019 campaign), and then validated in the Trebbia, Taro, and Enza rivers (2020 campaign). The three rivers are characterized by a braiding morphology, gravel riverbeds, and summer low flows. The RF model selected 12 mesohabitat descriptors as important for the macroinvertebrate community. These descriptors belong to different frequency classes of water depth, flow velocity, substrate grain size, and connectivity to the main river channel. The cross-validation R^2 coefficient (R^2_{cv}) of the training dataset is 0.71 for the Trebbia River (2019), whereas the R^2 coefficient for the validation datasets (Trebbia, Taro, and Enza Rivers 2020) is 0.63. The agreement between the simulated results and the experimental data shows sufficient accuracy and reliability. The outcomes of the study reveal that the model can identify the ecological response of the macroinvertebrate community to possible flow regime alterations and to possible river morphological modifications. Lastly, the proposed approach allows extending the MesoHABSIM methodology, widely used for the fish habitat assessment, to a different ecological target community. Further applications of the approach can be related to flow design in both perennial and non-perennial rivers, including river reaches in which fish fauna is absent.

Keywords : ecological flows, macroinvertebrate community, mesohabitat, river habitat modeling

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